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Review

INFLUENCE OF GENES, MORPHOLOGY, PHYSIOLOGY AND THE ENVIRONMENT ON REPRODUCTIVE CHARACTERISTICS OF INDIGENOUS GOATS IN NIGERIA: - A REVIEW

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The objective of this paper is to review influence of gene, morpho-physiology and environment on reproductive characteristics of indigenous goats in Nigeria. Planned breeding requires an understanding of characteristics of goats that are transmitted from one generation to another which is concerned with genetics of the entire goat population. However, the major objective of animal breeding is to increase the frequencies of desirable genes as to achieve the ideal genotype which will give the desired traits in a given population. Important traits in animals are influenced by factors like the environment as well as the genes over which man has no control. Reproductive potentials of a female animal is measured by the number of young ones produced per year, which depends on the age of the animal at first kidding, litter size, kidding interval and kidding rate. There is a considerable potential for increased goat production, provided that proper management is employed. Much will depend on recognition of their values as domestic animals. Substituting goat for cows in terms of milk production can increase the goat contribution to animal production, particularly with the small scale subsistence farmers. Better use can be made of scarce resources in developing areas because of potentially higher fertility of goats and higher feed conversion efficiency in relation to body mass for meat and milk production. Indigenous breeds of goats have the ability to adapt and reproduce under harsh environmental conditions. Goat primarily produces meat but also produce milk and their contribution to the nutrition of the rural poor are significant. They supply precious proteins of higher biological value in the form of meat and milk. Potential productivity of goats is constrained by poor understanding of the many values of goats and of strategies for improved natural resource management in the target environments. False perceptions that: 'environmental degradation, bias inadequate official support and resources use' are the major belief of people to rule against goat production. Goats are termed as destroyer of vegetation; this somehow hindered the farmers from exploiting the full potential of these animals. Theft, predation, poor veterinary services, poor hygiene and incidence of diseases and parasites in ascending order appears to be the most important problem limiting goat production in most tropical parts of Africa. Sound extension education program to overcome problems could be of great benefit to the rural farmer and the national economy.

Keywords: Genes, Physiology, Morphology, Environment, Reproduction, Goats, Nigeria.

INTRODUCTION

Nigeria has over 24.5 million goats representing almost 4% of world population of goats (Akusu and Ajala, 2000). More than 60% of the goats in Nigeria are found in the Sudan Savannah Zone of Northern Nigeria (Adalemo and Baba, 1993). The northern areas though receive less rainfall and have shorter wet season, most of the ruminant animals are produced there. The zone has abundance of crop residues, by-products and browses which support goat production. The area is also free from tsetse flies and other humidity related diseases and parasitic conditions which make it a favourable environment for improvement in livestock industry to be carried out to bridge the animal protein deficiency gap in Nigeria. In some parts of Nigeria, efforts have been made to substantiate or document substantive information on the productivity of indigenous goat breeds, as it relates to the influence of season, nutrition, and some biochemical/environmental conditions on their overall performance which are likely to vary within and between breeds and location (Bitto and Egbuinike, 2006). The objective of this paper is to have a critical review of genetic, morpho-physiological and environmental influence on reproductive characteristics of indigenous goats in Nigeria.

PUBERTY

Hafez (1980) stated that, puberty in goats is the period that precedes adulthood, which is when the animal becomes sexually mature. Puberty in goat is reached at an age which varies considerably with breed and also among individuals within a breed. Who further stated that attainment of puberty is associated with presence or absence of feed and disease. An animal is said to have attained puberty when it is able to release gametes and as well exhibited complete sexual behaviour sequence (Devendra and McLeroy, 1982) Puberty is basically the result of a gradual adjustment between increasing gonadotropic activity and the ability of the gonad to simultaneously assume steroidogenesis and gametogenesis (Hafez,1980).

Age at puberty

In goat, sexual maturity is realized quite early, therefore mating should be controlled or delayed to ensure that the dam is able to accommodate the foetus without competition for available nutrient for her own growth. Hence, age is not a good determination of the right time for mating (Devendra and McLeroy, 1982). The authors further reported that the boar goats in South Africa reached puberty at 157.5 days of age, with morphological sperm counts of 36.5 %, which rose to 89.8 % at 8 weeks. They went further to state that, "Damascus goat showed presence of sperm in ejaculate at 11th week of age in the bucks''. In normal breeding condition puberty occurs at about 4 – 6 months in goats (Devendra and McLeroy, 1982) and attainment of sexual maturity is more closely related to body weight than to age at puberty. If growth is accelerated by over feeding, the animal will reach puberty at a younger age. Also if growth is slowed down by underfeeding, puberty will as well be delayed (Devendra and McLeroy, 1982).

Social and climatic factors, mainly photoperiodism, modify age at puberty under natural condition where reproduction is a seasonal phenomenon; age at puberty depends on the season of birth, as ewes born in January reach puberty 8 months latter; but those born in April reach puberty after six months of age. At puberty, all the components of the male reproductive system have reached a sufficiently advanced stage of development for the system as a whole to be functional. The period of rapid development that precedes puberty is known as the pre pubertal period, although this period is sometimes referred to as puberty (Donokan and Vander-Werfften- Basch, 1965) During post-pubertal period, development continues and the reproductive tract reaches full sexual maturity months or years after the age of puberty (Hafez, 1980).

REPRODUCTION IN BUCKS

A desirable male buck should possess the following characteristics as being masculine in nature, physically strong, tall in height, the heaviest goat in the flock with a weight of 60 to 70kg, have wide chest and well developed barrel (Devendra and McLeroy, 1982). Buck should have straight body, be in excellent condition and have strong legs. The buck should not have any physical defects, very aggressive with rugged mane on the neck and shoulder which are reflects of good breeding ability, and finally have good semen characteristics (Devendra and McLeroy, 1982). Sexual activity in the bucks commences with the formation of

spermatozoa and the fluids which together comprise semen. The Sperms are stored in the epididymis where they can remain fertile for up to about 60 days, beyond this time they disintegrate and are absorbed (Steele, 1996).

Male reproductive organ (buck)

The reproductive organs of the buck have been described extensively by Devendra and McLeroy (1982). These organs include: the testis, epididymis vas- deferens, ampullae, seminal vesicle, bulbo-uretheral glands penis and the prepuce. The male reproductive organ in goats just like in any farm animal develop and grow in size relative to general body size, and under goes histological differentiation (Abdel-Raouf, 1960). The evaluation of the male for effective breeding is carried out prior to time of breeding to exploit the males maximum genetic potentials, and this is the most important aspect of a sound reproductive management program (Bongso et al., 1982). Similarly, Bonia and Rajkonwar (1985), measured the length, breath, thickness, diameter and weight of testes, epididymis, ductus-deferens, ampullae, seminal vesicle, bulbo-uretheral gland, penis and sheath of both left and right sides using standard scales, slide calipers and sensitive physical balance in Assam hills goats in Karbi. The authors found that there was no significant difference between left and right organs however, gradually increased with increase in age. They attributed the increase in size of organs to age/growth and reproductive activities of the animal.

Scrotal circumference (SC)

Scrotal circumference (SC) is an easy parameter to measure and is highly repeatable with heritability estimate of 0.26 (Meyer et al., 1990). Making selection in respect of increased SC is an important means of genetically improving the inherent fertility of a flock (Keeton et al., 1996). Scrotal circumference is also an important component in examining beef bulls for breeding soundness. Several reports have shown that SC is genetically and phenotypically correlated with important growth traits and other body measurements used in most selection programs (Keeton et al., 1996). It was also discovered that SC correlated positively with age at puberty in heifers and body sizes in Bunaji bulls in Nigeria (Osinowo et al., 1981). Adedeji et al., (2005) also discovered that age/ body weight interaction had significant effects on the SC. Same author pointed out the significant relationship of age by body weight on scrotal dimensions indicates that, as animal mature with increasing body size, the scrotal length and width deepens. Bulls with larger SC have been reported to produce more semen, have a higher prevalence of normal sperm and have greater sperm motility than bulls with smaller SC (Brad and Michael, 2007). Scrotal circumference may be useful in predicting the quality and amount of spermatozoa producing tissue (Hopkins, 2003) and age at puberty (Lunstra et al., 1979).

Testicular characteristics

These characteristics seldom referred to as testicular biometry which are the physical dimensions of the testes that include testis weight, scrotal circumference, testicular length, volume, width and thickness. These measurements are taken to monitor testicular development and to check their effects on the reproductive performance of the male and their female offspring (Elliot, 1973). Measurement of testicular dimensions made in intact live animal, have been shown to be closely correlated with measurements of the organ after removal (Yao and Eaton, 1954). A high correlation between testis diameter and organ weight for 3 breeds of sheep in two age groups was reported by Land and Carr (1975). The findings of Esbenshade et al. (1977) and Bratte et al. (1999) revealed that there are significant relationships between body weight, age and testicular size. Also Coulter and Foote (1977) reported that males with larger testes are more likely to possess large body size as a result of the anabolic effects of androgen, but the effects of age should not be ignored.

Relationship of testicular characteristic with male reproductive traits

A marked increase in testicular size is an indication of onset of active spermatogenesis (Bongso et al., 1982). However, semen output is said to increase with increase in size and weight of the testis and breeding potential in males can be determined using the quality and quantity of sperm produced and

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sexual activity (Colas and Caurot, 1977). Moreover, Cameron et al. (1985); Akingbeme and Aire (1989), stated that increase in total sperm output per ejaculate with increase in age was attributed partly to increase in testicular size. Semen production is said to be related to testicular development as shown by the positive correlation recorded between testicular weights, gonadal and extra-gonadal sperm reserve and sperm production (Butswat, 1994).

Given the attributes and high heritability estimate (0.4 – 0.7) of testicular size (Legault et al., 1980), its measurement would be a useful selective criterion for improvement of herds or flock fertility (Yarney et al., 1990). Testicular weight is an indicator of sperm producing capacity (Cameron et al., 1984). Several indirect measurement of testicular weight such as scrotal circumference and testicular diameter also provide good indications of spermatogenic function (Knight, 1977). But it may not be a very reliable measure of measurement in young animals where testicular tissue occupies a smaller proportion of scrotal volume (Yarney et al., 1990). However, Testicular dimension, e.g. scrotal circumference (a trait that correlates well with testicular weight) can provide an indirect measure of testicular weight. There is a high correlation between scrotal circumference and paired testis weight (0.95gm) in sheep (Willet and Ohms, 1957). Similar value (0.96) was reported by Notter et al. (1981), but lower values were reported by Coulter and Foote (1976) for mature rams and post pubertal bulls, respectively. Correlation between scrotal circumference and testicular diameter, though high R= 0.70 is relatively low at the early ages in lambs (at 30 days of age); but the coefficient increase with advancement in age reaching a maximum value r = 0.98 at 60 days. It then remain high until 17 – 18 months of age after which it will decline r = 0.79 (Yarney et al., 1990). Bongso et al. (1982) also reported that there is a close association between testicular growth and general body development in goats. Prepubertal growth rates have also been used to predict adult testicular size and spermatogenic function in bulls (Coulter and Foote, 1979).

Relationship between testicular characteristics and female reproductive traits

Most female reproductive traits have low heritability selection intensities (Smith et al., 1989). This however, necessitates investigation on their relationship with males' testicular characteristic to take advantage of higher selection intensity in males (Smith et al., 1989). Differences between breeds in testis diameter were related to differences in females' prolificacy (Amann, 1970). Testicular size of males relates positively to the ovulation rates of genetically related females (Land et al., 1980) and negatively to the onset of puberty and subsequent breeding seasons (Land et al., 1980). Land (1973) reported in mice and sheep that testicular size in male can be used to improve ovulation rate in their female offspring. Large testis weight in male mice is associated with larger litter size of related females (Eisen and Johnson, 1981). Selection for scrotal circumference in bulls improves age at puberty of heifer offspring (Brinks et al., 1978). It has been reported by Land and Carr (1975) that testicular development in ram is an indication of the rate of sexual development in the female siblings and future daughters. Due to high correlation estimate between some female reproductive traits and testicular measurements of the male's relatives (Toelle and Robinson, 1985), selection for testicular measurements was also considered better than direct selection. Smith et al. (1989) reported similar results between scrotal circumference and female reproductive trait. Correlation between male and female reproductive trait are attributed to control of gonads of both sexes by follicle stimulating hormones (Land, 1973)

Relationship between testicular characteristic and body weights

In the processes of trying to establish morphological differences between Malabari and Beetal goats, Bilaspuri and Singh (1993) recorded a high degree of relationship between body weight and testicular parameters. Similar findings in ram lambs and bulls were also reported by Makarechian et al. (1984) for Chigu goats aged 1 – 2 yrs and weighing 27.5 ± 1. 40 kg, their scrotal circumference averaged 23.6 ± 0.44 cm; weight of testes was 133.4 ± 6.7 gm while weight of adrenals was 1.54 ± 59.8 mg. Increased scrotal circumference was closely associated with increase in body weight in goats (Bongso et al., 1982) and could be used as the bases for estimating sexual maturity. A positive relationship between age, body weight and testicular characteristics in rams were reported by Bratte et al. (1999). Similarly, Adedeji and Gbadamosi (1999) reported a positive relationship between scrotal

circumference and body weight. Toure and Meyer (1990), found a positive relationship between scrotal circumference and body weight only in Young males. Irrespective of age, they stated that male with large testes possess large body sizes due to anabolic effect of androgen.

Functional Anatomy of Male Reproduction

Hafez (1980) stated that the male gonads and the testes lie outside the abdomen within the scrotum, which is a purse like structure derived from the skin and fascia of the abdominal wall. The testis is secured to the wall of the vaginal process along the line of its epididymal attachments. The position of the scrotum and the direction of the long axis of the testes are relative to the body difference within the species, (Hafez, 1980) and are usually two in number located side by side and oval in shape. The scrotum is the pendulous pouch that houses the testes. During the pre-natal developments, the testis at times fails to enter the scrotum, and the failure may be related to the anatomy of the vaginal process and gubernaculum (Smith, 1975). This condition is referred to as cryptorchidism. In cryptorchids, special thermal needs of the testis are not met, hence normal spermatogenic function is impossible but the endocrine function of such testis remain unimpaired. Cryptochid males may tend to show more or less normal sexual desire but are sterile (Hafez, 1980). Occasionally, some abdominal viscera pass through the orifice of the vaginal process and enter the scrotum leading to scrotal hernia which is most common in pigs (Hafez, 1980).

Endocrine function of the testis

The interstitial (leydig) cells which lie between the tubules are the source of the hormone testosterone (Hafez, 1980; Foster et al., 1980). The epithelium of the tubule consists of spermatogenic cells and supporting sustentacular (sertoli) cells. The basement membrane contains contractile myoid cells, and spermatozoa are produced by differentiation of the last of the several generations of cells resulting from the division of peripherally situated spermatogonia (Hafez, 1980). Maturation of the endocrine system between birth and puberty in goats was studied by Bonia and Rajkonwar (1985) who observed that in all measurements of dimensions the components of the endocrine system increased significantly with advancement in age. The two major functional roles of the testis are production of sperm, the male reproductive cells and androgen, the male hormone and are governed by the gonadotropic hormones (Hunter, 1982) and the initiation activity in the seminiferous tubules is highly linked to the follicle stimulating hormones (FSH). Pubertal increase in FSH is said to have been completed earlier than LH in rams (Yarney et al., 1990). Lutenizing hormone (LH) controls the endocrine activity of the cells. Yarney et al. (1990) reported that L.H pulse magnitude increases between 30 and 70 days of age in Suffolk rams, then decline progressively as adulthood is reached. Male sex hormone produced by the interstitial cells support the action of FSH on spermatogenesis and is responsible for development of secondary sexual characteristics and the growth and functional integrity of the male reproductive tract as a whole (Hafez, 1980). High concentration of pre-pubertal plasma FSH have been found and reported in highly prolific sheep breed, locally known as Boorola (Bridon et al., 1985) and also in Lacaune x Romanov cross breeds (Ricordeau et al., 1984). Also it was reported that testicular size and spermatogenic function of yearling Suffolk ram is related to LH and or testosterone secretion in the neonatal 50 days and pubertal rams at 150 days of age (Yarney et al., 1990). Castration of prepubertal males leads to suppression of sexual development, while regressive change in aggressive male behaviour and structure takes place when adult males are castrated (Hafez, 1980)

Exocrine functions of the testis

The spermatozoa leave the testis in an important fluid secretion called (rete-testis fluid) (Setchell, 1970). The rete-testis fluid differs greatly in composition from blood plasma and lymph. There is a special blood testis barrier formed by special cells of the basement membrane of the tubules and other special feature of the sustentacular cells which effectively separates the seminiferous epithelium from the general circulator (Dym and Fawcett, 1976). The barrier effectively divides two compartments of the testis with the parent spermatogonia separated by the sustentacular cells from their progeny. The integrity of the blood testis barrier is believed to be important for normal testicular function. It serves to separate immunologically, the germinal epithelium from the rest of the body tissues, and injuries that impair the

effectiveness of the barrier results in immunologic damage to the testes. The barrier is weakest at the rete-testis (Neaues, 1977). Heavy metals like candium is said to have some damaging effect on testicular function, due to the metals effect on the rete-testis barrier (Dym and Fawcett, 1976).

Sperm production by the testis

Sperm production heralds the onset of puberty and it requires a series of specialized cell divisions within the seminiferous tubules commencing with spermatogonia, then spermatocytes and spermatids (Hunter, 1982), while the sequence of cell type is supported and nourished by contact with nurse cells (Sertoli) cells of the tubules. He further stated that excluding instances of disease and nutritional deficiencies, production of spermatozoa continues from puberty to old age. The only exception to this is in animals that are seasonal breeders like deer and to a lesser extent sheep in which the cell divisions in the seminiferous tubules may be diminished or arrested.

The increase in number of sperm output per ejaculate with advancement in age was attributed to increase in testicular size (Akingbeme and Aire, 1989). Total sperm production in a species increases with body growth, reflecting increased testicular size and an increase in the seminiferous epithelium (Hunter, 1982).

FACTORS INFLUENCING SPERMATOGENESIS

Genetic factor

Sperm production in male animals is influenced by a number of genetic factors both during the pre- and post-pubertal growth. Such genetic factors include species, breed strain and individual differences (Hafez, 1980). Breed differences with respect to age at puberty have been reported by Gatenby (1986).

Occurrences of heritable sperm defects such as abnormal mid- pieces in sheep and goat was reported by Bloom (1961). Similar observation was also made (Orji, 1989) in tropical breeds of sheep and goats. However, the heritability of quantitative traits like sperm production or quality has not been fully documented. But, quantification of the sperm production capacity in breeding animal allows for the assessment of the efficiency of spermatogenesis in males kept under different environmental conditions and enhances artificial evaluation of effects of season, breed, and age, bioclimatic factors, hormones, chemical and drugs (Amann, 1983). Proper and profitable management can therefore be based on such information. Indigenous animals are both functionally and genetically valuable as they contain some genetic materials which have been lost in the improved gene pool (Adebambo, 2002).

The indigenous animals may possess relic characteristics of genetic variants that are either absent in modern improved stock that exist only in their rare ancestors. Such traits may be of commercial scientific, aesthetic or historic value. They may possess some rare and important traits such as adaptation to extreme weather /environmental conditions (temperature, stress, draught, disease resistance and high parasitic load) either as a result of selection pressure that may have resulted to an increase in the frequency of rare genotype or mutations and/or both (Adebambo, 2002).

Temperature effect on spermatogenesis

Normal production and ripening of spermatozoa can only take place at a temperature several degrees below that of the abdomen. There is a reduction of 4 - 7^0 C between abdominal and testicular temperature regulation of the difference being obtained particularly by the cremaster muscles that support the testes. The warmer the ambient temperature the more relaxed the cremaster muscles giving the testes and scrotum a pendulous condition thereby increasing their distance from the body cavity and cooling the body within (Hunter, 1982).

Heat applied directly to the testes will result in testicular degeneration in domestic animals (Largerlof, 1979). This is apparent several weeks later as increased incidence of spermatozoa with proximal cytoplasmic droplets, abnormal head forms followed by decreased or ceased sperm production. Animals usually attempts to cool their body by panting in an event that the heat regulating mechanisms of the testes fails to counter current blood flow, cremaster muscles and scrotal sweat glands (Dyrendahl, 1975). Goat with divided scrotum is believed to more effectively cool their testicular temperature than those that has one lobe (Nunes et al., 1984).

Fertility

Goats are considered to be fertile if they produce normal spermatozoa or ova capable of fertilization (Devendra and McLeroy, 1982). Fertility, as a measure of kidding performance is a breed characteristics and can be altered by selective breeding. It can also be modified by age, stage of breeding season when bred and by nutrition. The fertility of a male animal is related to several phenomena; sperm production, viability and fertilizing capacity of ejaculated sperm, sexual desire and ability to mate. Male fertility is affected by numerous factors like; age, maturity, nutritional status, general health, endocrine balance and normality of sex organs. Sperm quality, nutrition, body weight, maturity, stress, disease, mating frequency, seasonal and climatic variations, and management also play roles in male fertility (Raczykowski, 2007).

Influence of genetic factors on fertility

The genotype of individual breeds of goat is an important determinant of fertility (Devendra and McLeroy, 1984). The authors further stated that some physiological aspects of reproduction such as conception, twining and kidding interval have an indirect effect on fertility. The main aim of any breeding programme is for effective change in economically desirable traits of any domestic animal for optimum performance (Odubote, 1996). Fertility as measured by lambing performance is a breed characteristic and can be altered by selective breeding (Mavrogenis et al., 1984). This can be achieved by utilizing the knowledge of genetic parameter e.g. heritability, repeatability and correlation (Mavrogenis et al., 1984). Fertility and prolificacy has been reported to increase with age of the goat. In malabar goat, the proportion of twin and triplet birth increased from 19% in the first kidding to 79 % in the second and latter kiddings (Devendra and McLeroy, 1984) and that Kilis goat in turkey and Angora goats in Texas have reached maximum fertility at 5 and 7 years of age respectively.

Influence of environmental factors on fertility

Environmental factors, as well as ambient temperatures and seasonal changes, management factor including handling of bucks and does at mating, heat detection, time of service, mating ratio, nutrition, disease and parasite are important factors affecting quality of semen produced, volume and sperm count per ejaculate, viability, morphology, colour and morbidity of sperm cells are adversely affected. Estrus cycle, ovulation and conception rates are also reduced in goats (Devendra and Mcleroy, 1984).

Effects of nutrition on male reproductive performance

Insufficient dietary energy and proteins are often the main limiting factors of efficient goat production in the tropical environment (Devendra and McLeroy, 1984). Nutritional state has shown to have effect on productive performance of farm animals. Underfeeding is said to have retarded testicular growth and as well lead to a decrease in the number of LH and testosterone pulse per day. It was however assumed that hormones like FSH and GH are involved in the above circumstance (Gauthier and Berbigier, 1982). LH surge is believed to induce testicular testosterone secretion at puberty (Amann, 1983). But, Gauthier and Couland, (1983) reported that underfeeding depressed the testosterone LH feedback in the bull. This claim was established through an experiment conducted by Gauthier and Couland (1986), but was preceded by hemi-castration which increased GH and FSH Secretion (Al-hobody et al., 1988). Gonadotropic hormones levels in the blood are also found to be affected by underfeeding (Driver and Forbes, 1981). Twining studies have been used to determine effects of different diets, different therapy and any other modifications of the environments particularly with monozygotic twins (Waston, 1972). Using two dietary protein and energy level on sperm production in rams, Braden et al. (1974) concluded that high protein intake was not essential for high sperm production, but increasing the level of energy intake had a greater effect on sperm production than did increasing protein intake. Protein is considered to be one of the most important nutrients influencing testicular growth in farm animals. This is evidenced by the good relationships that exist between nitrogen balance and testicular growth in response to lupin feeding (Oldham et al., 1978). Allden (1968) reported that the shape of an animal may be altered to a certain extent by food restriction.

Devendra and McLeroy (1982) reported that diets

providing sufficient protein and energy encourage sexual mating in goat. However, digestible energy intake was reported to be the most important nutritional factor influencing testicular growth (Murray et al., 1990). And that reproductive function in young animal appears to be more susceptible to dietary restrictions of energy and protein than in an adult and severe feed restriction may result in permanent damage to gonadal and neural tissue.

Seasonal influence on male reproductive performance

Insignificant effect of seasonal variation was reported in black Bengal goat when supplemented for nutritional deficiencies during the dry season (Moulick and Syrstad, 1970). Similarly, a non-significant effect of season on Cheghu and Pashmma goats in India was reported (Biswas et al., 1990). In temperate regions both sexes of goat tend to be seasonal in sexual activity with a reasonable high degree of synchrony between the sexes (Hafez, 1982).

Day length variations clearly control spermatogenic activity in the ram. Also seasonal variation in semen production and quality are evident with total production and quality highest in the fall and lowest in spring and summer. A change from long to short day- lengths induces testicular growth after 3 weeks (Lincoln, 1976). Under tropical condition light appears to have minimal effects on reproductive functions (Carles, 1983). Temperature and day length affect total semen production and quality (Hafez, 1982). He further stated that high ambient temperature above 27^{0}C tend to depress semen quality and may result in summer sterility. In water buffalo and bulls, seasonal differences in their seminal quality have been reported by Sen-Gupta et al. (1963). While *Bos – indius* × *B. taurus* crosses, *B. brachyceros* and *B. taurus bulls* exhibited worse semen quality during the dry season than rainy season in Nigeria. There was no significant different between seasons for indigenous *B. indicus* bulls (Igboeli et al., 1987). Seasonal differences have been reported for seminal quality and quantity in Red Sokoto goats (Dauda, 1984). Also, shading of males from sunshine had no effect on testosterone and LH in goats and bulls, but this can lower prolactin level (Sergents et al., 1984). Seasonal variation has drastic effect on fertility of sheep raised in temperate environment, as high ambient temperate and changes in animal photoperiod led to decreased fertility (Cupps et al., 1957). Cupps et al. (1959) reported the detrimental effects of environmental temperatures on the characteristic viz., volume, concentration, motility and a live /dead sperm ratio of ram semen.

The Epididymis

The epididymis is responsible for the transport, concentration, maturation and storage of spermatozoa, and the cells lining the tubules have both an absorptive and secretory function (Glover and Nicander, 1971). The epididymis is closely opposed to the surface of the testis and the point of origin of the efferent ducts from the rete-testis lies under the flattered expanded head of the epididymis (Dym and Fawcett, 1976). Some biometrical studies on the male genital system have revealed the various dimensions of the parts of the epididymis in Assam hill goats in Karbi along district of Assam (Bonia and Rajkonwar, 1985) and Black Bengal bucks (Datta et al., 1989). The anatomic parts of the epididymis are recognized, namely caput, corpus and cauda epididymis. And the three can be distinguished histologically (Nicander, 1957). Seasonal variation has high significant effect on epididymal weight and sperm counts in bucks (Butswat and Zaharadeen, 1998), and that highest values were obtained during the early dry season and the least sperm counts value during the late rainy season. Epididymal weight values were also highest during the late dry season followed by the early rainy season, then the early dry season and least was for late rainy season. Secretory activity is a feature of the epithelium of the duct of the epididymis that is suppressed by castration, the secretion maintain the viability of the spermatozoa during storage (Hamilton, 1971).

Epididymal sperm reserve

Hafez (1982) reported that, the cauda epididymis constitutes a storage reservoir for spermatozoa as the condition in the cauda epididymis seems very conducive to the survival of the spermatozoa, and that accounts for the large turnover of spermatozoa in the cauda epididymis. The relative distribution of caput, corpus and cauda epididymal weight (g) and spermatozoa for Ouda rams have been reported by Akingbeme and Aire (1989). It is believed that in most species of animals a positive and significant correlation exist between testicular dimensions,

gonadal and extra-gonadal sperm reserve and sperm production (Amann, 1970). Queiroz and Cardoso, (1987) reported that the relative distribution of caput, corpus and cauda epididymal weight (g) are 8.5 ± 2.7, 2.4 ± 1.0 and 9.6 ± 2.9 respectively for Brazilian Hairy rams; while sperm content (x10^9) were: 3.6 ± 2.2, 1.8 ± 1.3 and 22.2 ± 1.36, respectively. Smaller number of spermatozoa in the corpus epididymis was attributed to its smaller tubular mass. The cauda epididymis which forms the bulk of the epididymal mass contains a greater proportion of the Epididymal sperm.

Extra-gonadal sperm reserve in goats is found to follow the same trend as reported by Jindal and Panda (1980), and more recently similar results using Black Bengal bucks have been reported by Datta et al. (1989), where the average number of spermatozoa (×10^7/ml) was found to be maximum in the cauda (1267. 966 ± 17. 728) followed by caput with (935.066 ± 6.802), corpus (436.933 ± 7.754) and Vas deferens (225.166 ± 6.180) in that order. Of the total extra-gonadal sperm reserve in the ram 15% are found in the caput epididymis, 4 % in the corpus epididymis and 68% in the cauda epididymis (Hafez, 1982).

The accessory sex glands

The major accessory sex glands are the paired seminal vesicle, prostrate and the Cowper's glands and are properly described (Hafez, 1982). These glands in close association with the duct cistern together produce the seminal fluid in which spermatozoa are ejaculated. These three glands pour their secretions into the urethra where they meet with the fluid suspension of spermatozoa and ampullary secretions from the ductus deferens during ejaculation (Hafez, 1982). Biometrical study of the accessory glands in goats have been studied by Bonia and Rajkonwar (1985). They found that both the right and left accessory sex glands increased gradually with age in all dimension with no significant bilateral asymmetry.

Accessory glands anatomic differences between farm animals have been summarized by Ashdown and Hancock (1980). Testicular androgens control the production of seminal plasma by the accessory sex glands (Hunter, 1982). Even though much is known about the specific chemical agents contributed by the accessory sex glands and the ejaculate, their function is still not certain. However, the accessory sex glands are said to provide a fluid medium for the transportation of spermatozoa during ejaculation (Hafez, 1982). In rams and goats the prostate is the primitive "disseminate" type and consists of glands that do not penetrate the muscles surrounding the pelvis of the urethra (Mann, 1964) and the relative contribution of the prostrate to the final ejaculation is very small.

Seminal vesicle secretion is usually more alkaline, has a higher dry weight and contains more potassium, bicarbonate acid soluble phosphate and protein and also high content of reducing substances such as sugar and ascorbic acid (Mann, 1964). In many species (e.g. bulls, ram, bucks and boars), the bulk of seminal fructose is secreted by the seminal vesicle, and the name prostaglandins (PG) would suggest that these compounds originated in the prostrate.

Most of the larger amount of prostaglandins that occurs in the seminal plasma of the ram originated in the seminal vesicles (Cenderella, 1975). Fructose and citric acids are important components of vesicular glands secretions of domestic ruminants. Glyceryl phosphoryl Choline is a distinctive component of the epididymal secretion. Ergothionin is found in the ampullary glands of the horse and the Jackass (Ashdown and Hancock, 1980).

The main function of the Cowper's or bulbo-uretheral gland secretion is the flushing of the urethra free of urine during ejaculation (Rodger, 1975) but the gland is absent in dogs. The seminal plasma constitutes the bulk of the ejaculate, particularly in species such as the boar and stallion and functions as a vehicle for conveyance of spermatozoa from the male to the female reproductive tract (Rodger, 1975). Seminal plasma contains many unusually organic compounds e.g. fructose citric acid, Sorbitol, inositol glycerylphosphoryl Choline and Ergothionin. Seminal plasma is said to be isotonic, neutral medium and in many species it contains a source of energy directly available to spermatozoa (Hafez, 1980).

Reproduction Failure in Males

Major functional aspects of male reproductive failure could result from anatomic, physiologic endocrinologic, environmental, nutritional, genetic, psychogenic or pathological factors (Jainudeen and Hafez, 1982).

Congenital malformation

Congenital malformation like; segmental aplasia of the Wolffian duct resulting from absence of the small or large segments of one or both Wolffian ducts (e.g. epididymis, vasdeferens or ampullae) are common in most farm animals (Jainudeen and Hafez, 1987). And that, such condition is characterized by a total or partial absence of one or both epididymis in bulls, but most often is the right epididymis. They further stated that congenital malformation normally leads to accumulation of spermatozoa within an occluded epididymis, known as spermatocele.

Cryptorchidism

In cryptorchidism, one or both testis fails to descend from the abdominal cavity into the scrotum. Testicular descent in mammals results from swelling and subsequent regression of the gubernaculum (Wensing, 1973). It was however postulated that gonadotropin deficiency might be responsible for failure of testicular descent, and that when human chorionic gonadotropin (HCG) or luteinising hormone – releasing hormone (LH – RH) is administered can promote testicular descent in swine (Colenbrander et al., 1978), and that bilateral cryptorchidism leads to sterility, while unilateral cryptochid male, may be fertile but have reduced sperm concentrations.

Testicular hypoplasia

Testicular hypoplasia is a congenital defect resulting from lack of potential development of spermatogenic epithelium, which leads to reduced fertility or sterility in which one or both testis may be affected (Almquist et a l., 1976). The authors also stated that bulls having this problem produce watery semen with few or no spermatozoa, however, in lesser forms; semen, libido and ability to serve are not affected but sperm numbers and the size of the testis may be reduced,

Ejaculate disturbances

Ejaculate disturbances may occur as a result of lack of libido or sexual desire (impotentia cocundi) (Hafez, 2000) and such condition may occur among farm animals due to hereditary or psychogenic disturbance, endocrine imbalance or environmental factors. Under this condition, seminal characteristic may be satisfactory (Hafez, 1982) but fertility can be adversely affected due to poor libido. Poor libido is believed to be due to deficiency in circulating androgens, but in Holstein bulls , the concentration of circulating testosterone is unrelated to libido or semen characteristic (Foote et al., 1976). Pain resulting from injury at copulation or association with mounting attempt is also a common cause of impotence in farm animal (Pickett and Voss, 1975). Seasonal factors, such as daylight and temperature, influence the sexual performance of rams under wide variety of both natural and controlled experimental condition (Hafez, 1982). Low libido in boar is associated with: obesity, heat stress, too high plane of nutrition and mismanagement of young boars during service (Hafez, 1982).

Inability to copulate

Physical ability may impede mating by causing failure in copulatory behaviour i.e. mounting, intromission or ejaculation (Hafez, 2000) but in bulls and boars, this could be associated with locomotor dysfunction due to dislocation, fractures and pain while intromission failure is as a result of penis failure to enter the vagina caused by insufficient protrusion of the penis from the sheath or deviation of the penis. Several other conditions namely; phimosis, hematomia, tumor of the glans penis, frenulum, penile hypoplasia and enlargement of the preputial diverticulum results in intromission failure (Ashdown and Hancook, 1980).

The structure and anatomy of the penis and prepuce play a vital role in intromission and have been described in detailed for the farm animals (Hunter, 1982). A biometrical study of the penis and prepuce in goats revealed that in mature bucks, (n =6), the penis measured 23.42 ± 0.81 cm long, but the free end is only 4.02 ± 0.11 cm (Bonia and Rajkonwar, 1985). The sheath had a length of 6.80 ± 0.34 cm (Ashdown and Hancock, 1980).

Nutritional influence and infertility in male farm animals

Nutritional deficiencies delay the unset of puberty and depress production and semen characteristics in the males (Hafez, 1982). It also affects the endocrine rather than the spermatogenic function of the testis. Underfeeding resulting from feeding low energy ration over prolonged period affect libido and

testosterone much earlier than semen characteristic (Mann, 1974). Obesity and overfeeding reduce libido and sexual activity in rams, boars and bulls particularly during the hot weather. Also deficiency of dietary Vitamin A leads to testicular degeneration in all farm animals, and iodine deficiency is being suspected as a cause of poor libido and semen characteristics in bulls (Hafez, 1982). It has been reported that toxic agent e.g. plant estrogen exert a diverse effect on male accessory organ (Mann, 1974).

Infertility resulting from chromosomal aberrations

The influence of chromosomal aberration on reproductive failure in males such as Klinefelter's syndrome, which is associated with testicular atrophy aspermatogenesis and fertility in buck, rams and humans have been reported by Bishop (1972). Other forms of aberration include chimerism, as reported in bulls born co-twine to Heifer by Bouters et al. (1972). In Pseudo hermaphrodite horse believed to be bilaterally cryptochid 64XX/65XXY mosaicism was revealed (Bouters et al., 1972). The animal showed strong male behaviour and had a smaller penis, which on erection release watery fluid devoid of spermatozoa. Bongso and Basner (1976) reported cases of infertility in several breeds of cattle due to the Robertsonia translocation, a situation where structural rearrangements of chromosomes may lead to breakage and reunion of two acrocentric or telocentric chromosomes. However, Robertsonian translocation in rams (53 XYt_1, $53XYt_2$ and 52XYt3t3) does not affect fertility of affected sires or their daughters (Bruere, 1975). Another form of chromosomal aberration is called autosomal constriction. This condition results from chromatid breakage or secondary constrictions in large and medium sized autosomes. This aberration is associated with low fertility (Bongso and Basner, 1976).

REPRODUCTIVE ORGANS OF DOES

The female reproductive organs are composed of ovaries, oviducts uterus and cervix, vagina and external genitalia (Hafez, 1982). Each of these organs play specific role in the reproductive life of the doe. Each organ develops and grows in size relative to body weight as they undergo histological differentiations (Nishikawa, 1959).

INDICES OF EFFECTIVE REPRODUCTION IN GOATS

The number of kids produced per female per year measures reproductive potentials in goats, and is determined by age at first kidding, rate of service per conception and service period (Devendra and McLeroy, 1982). Poor reproductive performance of tropical goats as compared to temperate breeds have been documented (Wilson, 1989) However, Awemu et al. (1999) stated that the ability of does to give birth to kids is a major factor that determined the production potentials of the doe under variety of production systems. Research has shown that there is no seasonal influence on reproduction in local breeds as the case with temperate breeds (Wilson, 1989). And since temperate breeds kid only once in a year, reproduction in native goats should not be considered lower in comparison to the temperate breeds as they are believed to be highly adapted to the tropical harsh weather and have good fitness trait (Olayiwole and Adu, 1989) and are able to produce under harsh environmental conditions (Kiwiwa, 1992).

Age at first kidding

The earlier a doe starts to kid the longer her productive life span will be (Devendra and McLeroy, 1982). However, they further stated that early mating, based on physiological maturity is highly undesirable due to the competition for nutrients that takes place between the foetus and the dam. Age is not a good criterion for first service, but weight is most preferable (Wilson, 1989) and for various tropical breeds of goats, in different locations, age at first kidding is between 15 to 26 months. Life time productive performance in goats is determined by the age at which the breeding female is allowed to conceive (Wilson, 1989). Report from 10 countries in Africa south of the Sahara gave an un-weighted mean of 513 days, about 17 months as age at first kidding with a range of 423 to 640 days (Wilson, 1989). Age at first kidding among female does in Togo is 450 days (Amegee, 1988) and 482 days for West Africa Dwarf goats in Nigeria (Ebozoje and Ikeobi, 1998). It ranges between 418 to 502 days for WAD goats in Chad (Dumas, 1980) and 401 days for Sahel goats (Girbaldi, 1978). Haumesser

(1975) reported 427 days for Red Maradi while Kyomo (1978), reported a higher value of 810.78 days as age at first kidding for small East African goats and their crosses. Similar values were reported for the small East African goats by Mtenga et al. (1994). A lower range of 301 to 431 days was reported from studies in the traditional sector of Sub-Saharan Africa by Wilson (1988). Murayi et al. (1987) reported from a research station in Rwanda that does should be mated at the age of 12 months and weighing 20kg for the first time. Animals that miss this target are therefore mated at an older age and higher weight since there is only one breeding season.

Pure bred exotic breeds have been reported to first kid at an advanced age compared to indigenous goat (Mtenga et al., 1994). Malabari goats first kid at a younger age than Jamanapari × Malabari goats (Raja and Majunda, 1974). Small East African goats were younger than Anglonubian × Small East African crosses at first kidding (Wilson and Murayi, 1988). These reports were quite contrary to the little variation recorded between Indian native and crossbred goats (Devendra and Burns, 1970), while Kyomo (1978) reported a non-significant difference between small East African goats and Kamorai × small East African goats in terms of age at first kidding.

First kidding in single litter females normally takes place earlier than from multiples births (Wilson, 1989). This report is supported by various research findings (Mtenga et al., 1994). However, a report by Ebozoje and IKeobi (1998) revealed that age at first kidding had no relationship with type of birth in West African dwarf goats. Also, the year of birth is believed to have effect on age at first kidding (Wilson et al., 1989). Though period of birth has to do with differences in management and climatic variations between years, good management and favourable climatic condition can result in early age at first kidding (Wilson, 1988), and parity can influence age at which a doe will have her first kid.

Litter size

Litter size is the number of kids born per doe, per 100 does per year or per litter, but these values are not very good indication of fertility since oestrus and number of birth is a function both of breed and various environmental factors (Devendra and McLeroy, 1982). The mean number of kids born alive per kidding is an important factor that determines the level of production as it contributes to the total number weaned than the growth rate of the kids (Bradford, 1985). Based on the relationship that exists between litter size and ovulation rate and embryonic survival, improvement in embryonic survival can lead to tremendous improvement in uniformity of litter size at birth (Bradford, 1985). Several research works as analyzed by Wilson (1989) showed that African does averaged 1.38 kids at parturition with a range of 1.08 to 1.74. Devendra and Burns (1983) reported that the average for Black Bengal goats, Malabari, Sirohi and Misra goats respectively fall within this range but lower values were also reported by other authors. An average of 1.7 kids was reported for Red Sokoto (Awemu et al., 1999), while Thiruvenkadan et al. (2000) reported an average of 1.93 kids for Kari Adu goats in India. For West Africa dwarf goats in Nigeria, the average is 1.79 and 1.82 respectively (Ebozoje and Ikeobi, 1998). While Amegee (1988) reported an average of 1.84 as being litter size from a population of west Africa dwarf goats with 33% single births, 54% twins and 13.% triplets in Togo. Under controlled conditions and particularly for tropical breeds of goats that display oestrus all year round, litter size is a useful method for fertility determination (Devendra and McLeroy, 1982). There exist a high degree of relationship between colour variation and litter size in goats, as pigmentation intensity is believed to have effect on reproduction in WAD goats (Ebozoje and Ikeobi, 1989). These authors reported that black pigmentation favours good litter size with white pigmentation having the least litter size. But Odubote (1994) had a contrary view when WAD goats are raised or managed intensively.

Season of birth is reported to have influence on litter size as kidding during the early rainy season had largest litter at birth (Awemu et al., 1999). This is in conformity with the findings of Silva et al. (1998) that, difference in feed availability and temperature variation between seasons could be responsible for this. These variations in addition to management systems between years also contribute to influence of year of birth on litter size (Awemu et al., 1999).

Prolificacy has positive relationship with advancement in age (Epistein and Herz, 1964) with maximum number of kids between 5 and 7 (Shelton, 1961). So also parity has significant effect on litter size. Large litter size was realized at the fifth parity in red Sokoto goat breed in Nigeria (Awemu et al.,

1999). But Odubote (1996) recorded the highest litter size at 6th and 7th parity respectively in WAD goats. Low prolificacy is persistent among primiparous does since their reproductive features have not reached advanced stage of physiological development and maturity compared to the multiparous (Awemu et al., 1999).

Kidding interval

The number of days between two successive kidding determines the kidding interval, and is a useful means of measuring fertility and productivity between breeds (Devendra and McLeroy, 1982), such interval comprises of the service period, the period between kidding and conception and the gestation period. Interval between kidding is a good predictor of life time productivity in goats, as prolonged interval is said to be responsible for low overall productivity of goats and sheep on a Massai group ranch in south Central Kenya (Wilson et al., 1985).

Under controlled mating condition on a university, farm in Burundi, the Small East Africa goat kidded every 213 days, (Branchert, 1985). Similarly, a value of 215 days kidding interval was reported for Red Sokoto goats (Awemu et al., 1999) and black Bengal goats (Pattanaik and Mistra, 1985). Under the traditional system of husbandry in Togo, kidding interval in WAD goats is 208 days (Amegee 1988), while it is 229 days for Kanni Adu goats (Thiruvenkadan et al., 2000). All these value are shorter than the value reported for Gaddi, Ganjam, small East Africa goats and their crosses by Mtenga et al. (1994).

Major factors responsible for variation in kidding interval is attributed to fixing of mating time (Wilson et al., 1989). Confinement and control mating delay kiddings (Wilson et al., 1989). Parturition interval decreases with parity (Wilson and Light, 1986). Reduction in kidding interval starts from 5th parity in WAD goats (Odubote, 1996). Similar observation in Red Sokoto goats was reported by Awemu et al. (1999). Variations due to year of kidding were also reported by Awemu et al. (1999). However, season of previous births has been identified as a major source of variation in kidding interval (Mtenga et al., 1994). Kidding interval is shorter in does that kidded during the late rain than those that kidded during any other season of the year. This is in conformity with the findings of Wilson and Durkin (1988). The influence of season of birth on kidding interval may be related to the availability of good forage during conception and pregnancy (Wilson and Light, 1986). Yearly variation in kidding interval is an indication of variation in management and seasons between years (Odubote, 1996).

Kidding rate

The number of kids born per does exposed to bucks or it could be related to the number of kids weaned in relation to the number of does mated (Devendra and McLeroy, 1982) or it could also be defined as the number of kids per breeding female per year (Wilson, 1989). Kidding rate of 1.6 for goats on extensive management in Mali was reported by Wilson (1984). This is similar to 1.8 reported by Thiruvenkadan et al. (2000) for kanni Adu goats in India. But higher value was reported by Mellado et al. (1996).

Kidding rate is expected to increase with increase in litter size or reduction in kidding interval (Wilson, 1989). Kidding rate can be influenced by factors like; breeding and gestation season, length of the breeding period and body condition score of both bucks and does (Acharya, 1982). Increased rate of abortion accruing during the drought period can seriously affect kidding rate (Mellado et al., 1996). Highest kidding rate (42.96) was recorded during the rainy season compared with other seasons of the year in Kanni Adu does (Thiruvenkadan et al., 2000) due to low temperature and good herbage growth.

Length of breeding period is positively correlated with kidding rate and high levels of reproductive performance may be obtained when the breeding period is more than 21 days (Mellado et al., 1996). More than 70% of does having good body confirmation responded to buck stimulation during the first eight days of mating (Garcia and Rattle, 1988). As such animal with short oestrus cycle, have limited opportunity of ovulating twice when mating periods are shorter than 21 days (Mellado et al., 1996).

Body condition score is perhaps the most vital factor influencing ovulation rate (Gunn and Doney, 1975), occurrence of oestrus and response of does to buck stimulus (Mellado et al., 1996) and consequently, litter size (Newton et al., 1980) and embryo survival (West et al., 1991). Kid rearing percentage is a very useful indication of production efficiency, but is not often used (Devendra and McLeroy, 1982).

Service per conception

This is the average number of service required per conception or per birth carried full term in the flock, that is when does are mated under controlled condition (Devendra and McLeroy, 1982) and service per conception records for goats vary from 1.1 to 2.3

Service period

Devendra and McLeroy (1982) reported that kidding interval is affected by the length of the service period, and for maintenance of flock fertility and productivity a short kidding interval is desirable. They went further to state that, in all breeds of goats, service period is influenced by the breed, but can be managed by careful husbandry practices. The same authors further stated that kidding interval among tropical goat breeds is shorter (90 – 150) days, while that of European breeds is longer (169 – 327 days). Imported into the same hot environment, indigenous goats breed all year round, twice or thrice i.e. per years or per 2 years while the temperate breeds are seasonally Polyoestrus and usually breed only once a year (West et al., 1991). Variation in day length, a characteristic of temperate areas affects sexual activity in goats (Devendra and Mcleroy, 1982).

The Ovary

The ovary is the reproductive organ in female animals which represents the testis in the males, and they perform both exocrine and endocrine functions, releasing egg and secreting oestrogen and progesterone respectively (Hafez, 2000).The shape and size of the ovary varies with species and between breeds and as well with time of estrus and it increases four to seven times the birth weight on onset of puberty (Hafez, 1982). He also stated that, both the right and left ovaries appear to perform equal function, but the right ovary in ruminant is thicker than the left. In the native Assan goat breed, a similar observation was made by Das et al. (1983).

Maturation of ovarian and pituitary functions in small ruminant from birth to time of puberty is poorly documented. However, differences in gonadal development have been demonstrated at birth in ewes of the Booroola, Finn cross and Romanov breeds compared to those of non - prolific local controls (Tassel et al., 1983). These differences in ovarian follicular population could be responsible for the breed differences in circulating FSH if it is assumed that the pituitary of ewe lambs is sensitive to ovarian feedback products such as oestradiol and inhibin (Sonjaya and Driancourt, 1984).

Histomorphological and histochemical aspects of the ovary

Histomorphological and histochemical studies on the ovaries have been reported in goats by Singh and Prakash (1988). Morphologically, the ovaries in goats are oval in shape and varied in size. It is about 0.7 to 1.6 cm in length; the width is 0.5 to 0. 9 cm and is 0.2 to 0.4 cm in thickness (Roberts, 1971). The ovary of small ruminants especially goat and sheep, ranges from 0.3 to 1.9 cm in length, weighing between 0.8 to 1.2 grams (Getty, 1975). Dissected features of the ovary revealed two clearly demarcated zones, namely; the cortex or zone paranchymatosa i.e. the peripheral zone measuring 375 to 490 µm, then the medulla or zone vasculasa, i.e. the central zone, measuring 215 to 365 µm in thickness (Singh and Prakash, 1988). The cortex is surrounded externally by a germinal epithelium, but for a limited site of stratification, the epithelium is simple and composed of squamous, cuboidal or columnar cells measuring 5 to 20 µm in height in younger goats, the epithelium is usually cuboidal or columnar, with the capacity to metamorphose to squamous cells with the advancement in age (Singh and Prakash, 1988). Similar reports were made by Ham and Cormack (1979). The existence of small patches of columnar cells in the germinal epithelium of adult goats can be termed as a potential source of Oocytes, active only when previous store of Oocytes are exhausted (Raps, 1948). Stratification of the germinal epithelium is as a result of the burrowing of the epithelial cells after ovulation (Singh and Prakash, 1988). Underlying the germinal epithelium is a thick layer of tunica albuginea composed of coarse areola connective tissue with fibroblast cells and fiber oriented parallel to the ovarian surface when this layer is formed, new primary follicles are not formed but invagination of epithelial cords through tunica albuginea to form primordial follicles occur throughout life more especially in the bitch (Trautmann and Fiebiger, 1957).

Cortical stroma consists of a higher proportion of fibroblast like cells and fibers oriented in various

directions. The cells are spindle – shaped and contain large oval and dark stained nuclei. The stroma is interrupted by various stages of follicular development and regression (Singh and Prakash, 1988). They also found out that the premodial follicles were restricted to the peripheral areas. They contain a large central cell; Oogonuim surrounded by a single layer of squamous cell – the follicular or the granulosa cells. These follicles were found to be in vast majority in young goats, but later the ratio changes in favour of the growing ones. The follicles were mostly oval in shape and their size (Short × long diameter) varied from 16 × 32 µm to 80 × 96 µm (Singh and Prakash, 1988). A few polyovular follicles were also observed by these authors in sheep during both proestrus and oestrus periods. These follicles were assumed to be freaks produced by somewhat excessive activity of the gonadotropic hormones of the pituitary gland. The primary follicles with multi-layered cuboidal or polyhedral cells around the Oogonuim were found to have occupied deeper parts of the cortex (Singh and Prakash, 1988). These authors further stated that the primary Oocytes is separated from the follicular cells by a thick and dark pink stained glycoprotein layer called the zona pellucida. The cytoplasm is found to be bounded by a combined plasma membrane and oestrus period covered by a vitalline membrane which appears as one structure after fixation and staining. The nucleus is spherical, and is contained in a well stained chromatin network with a prominent eccentric nucleolus (Hafez, 2000) The largest follicle measured 320 µm in length and 240 µm in width and the Oocytes is 80 µm in diameter (Singh and Prakash, 1988), where the diameter of such follicle is recorded to be 114 to 133 µm in Indian buffalo and 120 µm in cow.

The histological/histochemical study conducted by Singh and Prakash (1988) included demonstration of PAS positive material total lipids, phospholipids, acid mucopolysacharides and calcium and ion deposits in various parts of the ovary. They observed that, the PAS positive reaction was contained in the zona pellucida, cytoplasm of Oocytes, follicular fluid and ground substance of the cortex and medulla. They also observed similar changes in cattle, sheep and buffalo and finally reported that reactivity increased in follicular fluid and corpus luteum with the advancement of age, which they attributed to proportionate increase in the mucopolysacharide content of the fluid and follicular hormones.

Sudanophilic reaction was observed in membrane granulose and theca interna cells of the ovarian follicles theca and granulosa lutein cells of corpus luteum and the cortical and medullary stromal cells (Singh and Prakash, 1988). The reaction was more intense in larger follicles and aging copra lutea (Fienberg, 1963) where the presence of phospholipids coincided with that of lipids; however, larger follicles and maturing luteal cells showed milder reaction. They showed an increased in colloidal iron content in liquor follicle of degenerating follicles of the buffalo ovary (Singh and Prakash, 1988).

Ovarian weight at maturity

The first oestrus period normally occur when the doe is 4 to 10 months of age, (Hafez, 1974). This is feasible under ideal management, good health and on the genetic makeup of the animal. Knowledge about the weight of the ovary at maturity is lacking but Das et al., (1983) reported that the right ovary is significantly heavier than the left one (1.21 ± 0.0.2g and 1.10 ± 0.62g) respectively in the does that are in kidding.

INFLUENCE OF SEASONAL VARIATION ON OVARIAN ACTIVITY, OVULATION AND KIDDING RATE

Season has significant effect on ovarian activity as well as kidding rate. Alaku and Moruppa (1984) stated that during the adverse dry season, there was a significant weight loss in the internal organs of the goats. They attributed this to inadequate and poor quality feeds. They further stated that the weight loss is higher in Red Sokoto goats than in Borno white breeds. Ovarian activity in red Sokoto goats lasted throughout the year, being highest during the rainy season (June – September), and dry season (January – March), (Hambolu and Ojo, 1985). This they attributed to the availability of pasture during the wet season and ability of the goats to convert the browse leaves and other dry forage available during the dry season into useful nutrients. However, Devendra (1970) stated that dry season has less effect on kidding rate which occurs 2-3 times in 2 years in Red Sokoto goat breeds. Seasonal (variation in the ovarian activity was assessed by laparoscopy where the number of corpora lutea was taken to represent the ova

ovulated (Thimonier and Mauleon, 1969). Observation in slaughter houses indicates that ewes and does are ovulatory throughout the year, although variations in the ovulation rate are observed (Hambolu and Ojo, 1985). Daily detection of oestrus and regular observation of the ovaries by endoscopy have demonstrated regular oestrus and ovulatory activities in well fed Creole meat goats (Chemineau, 1986).

When small ruminants from high and mid-latitudes are moved to low latitudes they are still seasonal breeders, e.g. Alpine goats in the West Indies, Seanen and Toggenbury goats in Cuba (Carmenate, 1977). In small ruminants, seasonality is limited to animals originating from mid and high latitudes while the indigenous breeds of the Tropics are able to reproduce throughout the year (Thimonier and Chemineau, 1988).

INFLUENCE OF LACTATION, PHOTOPERIOD AND TEMPERATURE ON OVARIAN ACTIVITY, OVULATION AND KIDDING RATE

Goats from low latitudes are less sensitive to photoperiod than those from the mid-latitudes (Devendra and Burns, 1983). African dwarf bucks imported into Germany do not present clear seasonal variation in either mating activity or Semen quality (Mann, 1981). In domestic (Mammals) such as cattle, and swine, seasonality is inconspicuous, while in sheep and goats it is distinct. Numerous experimental studies have shown that the most efficient climatic factor is the variation of the daylight ratio. The action of the light/dark period mechanism is not completely understood; however, photoperiodic manipulation appears to be an efficient tool for increasing fertility (Hafez, 1982). Under constant photoperiod, breeds from mid – latitude have an endogenous rhythm of reproduction (Thwaites, 1965) although asynchrony between individuals and irregular ovulatory and oestrus cycles are sometimes observed. These observations have been confirmed with the alpine goat under either “Simulated Tropical or Simulated temperate (Control) variation of day length in a temperate climate. In goats, the sexual season is well defined in temperate climates. The Ovaries in the alpine goats are slightly active from February to March and quiescent from April to July; activity is abruptly resumed in all goats in September (Hafez, 1982).

Oestrus without associated ovulation and ovulation without oestrus occurs more frequently in goats introduced to the tropical photoperiod than in the controls (34% Vs 8%) and (31% vs 18%) respectively (Hafez,1974). Similarly, the frequency of short oestrus cycle having a mean duration of 7 days was also higher (36% vs 14%) in goats subjected to the tropical photoperiod (Chemineau, 1992). Daylight ratio and temperature are the two main climatic factors influencing the annual sexual cycles (Chemineau, 1982). The former is the most efficient factor. However, an experiment shows that photoperiodism is basically a synchronizer of sexual activity (Hafez, 1982). Seasonal variation of temperature plays a major role in the regulation of sexual function in lower vertebrates, particularly in reptiles. In mammals, when environmental temperature remain within the limit compatible with thermoregulatory mechanism, seasonal temperate variation effect on fertility is rarely reported (Hafez, 1968). High thermal environment is one of the main factors modifying the reproductive performance of female, and that embryo survival is dependent on ambient temperature after breeding time. The critical period of heat sensitivity in cattle lasts from day 1 to day 10 after artificial insemination (Ortavant and Loir, 1980). Local breed of animals in the tropical climates are less sensitive to high ambient temperatures compared to the temperate breeds. However, climatic factors influenced greatly the productivity of sheep and goats, especially under traditional system of management through their effects, principally on forage, water availability, thermal stress and photo period, which are reflected as seasonal trends in growth, reproduction, lactation and mobility. The seasonal variation in reproductive status of sheep and goats in the tropics is poorly understood (Hafez, 1980).

Under good management within the tropics, indigenous local cows, ewes and does suckle their young and are partially milked, and it is also on record that ovulatory activity occurs even during the period of lactation in Cre’ole ewes and does (Chemineau et al., 1982). This is also emphasized by the short interval between lambing and kiddings. Riera (1982) discovered that high mortality in lambs and kids occur as a result of sort interval constantly observed between parturition and conception. But it is believed that ovulation and related reproductive activity are suppressed for a variable `period after parturition and during lactation in several species (Chupin et al., 1976).

INFLUENCE OF NUTRITION ON OVARIAN ACTIVITY, OVULATION AND KIDDING RATE

Both season and level of nutrition affect the ovulation rate in angora breeds of goats. High-energy diets induce a higher ovulation rate in the pig when the diets are fed for a restricted duration (Anderson and Melampy, 1972). However, a single feed flush seems to have little beneficial effect on ovulation rate (Staigmiller and First, 1973). Also Anderson (1975) stated that there is little evidence that increased protein intake during brief periods increase ovulation rate. In several research works involving indigenous cattle, significant correlations have been established between monthly rainfall and monthly calving percentage or conception rate (Wilson and Lapwood, 1979, Gauthier and Xande, 1982) with various lags. Similar relationships have also been indicated in sheep and goats (Gonzalez-Stagnaro, 1984).

Rainfall is almost solely responsible for forage production in the tropics, where almost no supplementary feeding is practiced. Feed availability is not only dependent upon the rainfall but also its quality in terms of nutrients like, crude protein, Energy and Nutritional Value e.g. digestibility and the fibre content (Riera, 1982). As a result, nutritional status is one of the main factors controlling reproductive activity in farm animals (Thimonier and Chemineau, 1988). Nutrition therefore has an important impact on reproductive performance in farm animals. Improved nutrition increase ovulation rate and letter size, both long and short term effects of nutrition have been studied extensively (Smith, 1985). Also marked seasonal changes in ovulation rate occur during the period of seasonal ovarian activity (Land et al., 1973). Diets varying in total energy and protein content gave responses (in terms of Lambing percentage in sheep) indicating that the relative importance of protein or energy alone was inversely related to the amount of each provided in the diet (Torell et al., 1972).

The magnitude of nutrition effects on reproduction can vary with season. Nutrition has great influence on postpartum anoestrus and fertility in beef cattle during winter (Montgomery, 1985), and it has been suggested that the ovulation rate response to nutrition in the Sheep may vary during the year (White et al., 1983). Conception rates in sheep and goats in temperate zones during mid-breeding season are about 85% (Hafez, 1982), but fertility is depressed near the equator at the beginning and end of the breeding season, during hot weather in under nourished or overtly fat females, in young and old animals, when estrogenic content of the forage is high, and when the females are parasitized or suffering from disease or other stress. Under high and mid-latitudes (> 4^0), small ruminants are known to be seasonal breeders (Hafez, 1982).

Sexual activities are driven by photoperiod and births occur once a year by the end of winter, beginning of spring which is the best period for offspring survival and growth (Ortavant et al., 1985). Under low latitudes between the tropics, farm animals and ruminants in particular encounter a complete different environment characterized by low annual variation of daylight, high ambient temperatures, and wide variation in food availability in relation to the patterns of rainfall. Moreover, the management of the animals frequently differs from that observed under mid-latitudes and may modify the reproductive ability of animals (Thimonier and Chemineau, 1988).

CORPUS LUTEUM

The major site of progesterone production throughout gestation period in farm animals is the Corpus luteum (CL) (Rexroad and Casida, 1977), and it is essential in maintenance of pregnancy in all species of animals. They reported that progesterone also acts both systemically and locally to alter time-dependent changes in follicle size, thus making it possible for some follicle to grow, while others undergo atresia. However, the effect of progesterone on follicular growth rate does not appear to mediate through induction or alteration of ovaries oestradiol – 17β content (Rexroad and Casida, 1977).

Corpus luteum develops after the collapse of the matured follicle at ovulation (Hafez, 1980). It is formed from cells of both granulosa and thecal cells with granulose cells showing hypertrophy in the earlier stage of development.

In aged animals, the function of the Corpus luteum decline as a result of or inability of follicle cells (granulosa and theca internal) to respond fully to hormonal stimuli; changes in the quantity and for quality of hormones secretion, and reduced stimulus for hormone secretion (Erickson et al., 1976). The theca cells tend to regress during early stage of development and then atrophy (Cupps et al., 1959).

Removal of C. L at any stage of pregnancy results in abortion, but pregnancy can be maintained by replacement therapy with progesterone (Irving et al., 1972).

Corpus luteum (Cl) development, growth and regression

The increase in the size and weight of the C L is initially rapid (Erb et al., 1971) and the period of growth is slightly longer than half the oestrus cycle. In the cow, the weight and progesterone content of the C L increases rapidly between days 3 and 12 of the cycle, and remain relatively constant until day 16 when regression begins (Hafez, 2000). Corpus luteum growth is enhanced by lutenizing hormones (LH), its secretion is grater and its life is extended and during the period of ovarian cycle, the concentration of the L. H. is very low. The changes in the material plasma concentration of progesterone have been reported by Thornburns and Schnieder (1972) and Irving et al. (1972). They further stated that material plasma concentration decreased slightly during the first 40 days of pregnancy from the level reached during the luteal phase of the cycle. Secondary increase in progesterone concentration was also observed between days 3 to 50 of pregnancy which was maintained until some few days before parturition (Irving et al., 1972), and the increase was greater in twin bearing animals. Thornburns and Schnieder (1972) suggested that the secondary increase in progesterone level may have resulted from gonadotropic stimulation of C L by a placental hormone and that the removal of this tropic support may lead to luteal regression and parturition. The diameter of a matured CL is larger than that of a matured graffian follicle, it varies from 0.65cm to 1.20 cm (Das et al., 1982), and that the diameter of the CL is significantly greater in the right ovary than the left (0.98±0.01cm Vs 0.86±0.06cm) and the fresh weight varies with the stage of development (Das et al., 1982).

If fertilization does not take place, the corpus luteum regresses, allowing other larger ovarian follicles to mature (Hafez, 1982). As these cells degenerates, the whole organ decreases in size, becomes white or pale brown known as Corpus albicans (Hafez, 2000). Bovine corpus luteum of the oestrus cycle begins to regress 14 to 15 days after estrus, and its size may be halved within 36 hours (Hafez, 1982).

Influence of corpus luteum on follicular development, ovulation and pregnancy

The Corpus luteum has a possible stimulatory effect on follicular development and ovulation through a local intra-ovarian mechanism (Hafez, (1982) and that the presence of already formed corpus luteum increased the efficacy of pregnant mare serum gonadotropin (PMSG) in inducing ovulation in ewes. The main source of progesterone is the luteal cells of the C.L. Although progesterone has been isolated from the adrenal cortex and placenta of many animals, its main physiological source remains the Corpus luteum. During late pregnancy, placenta may become a source of progesterone in some animals, although in cows, this does not appear to be so (Hafez, 2000).

Progesterone is necessary for maintenance of pregnancy, and it as well acts on the uterus to cause quieteining of the myometrium and secretion of uterine milk by the endometrial glands (Hafez, 1982). The author further stated that large doses of Progesterone inhibit gonadotropic output of the pituitary gland. In some cycling animals e.g. cow, sheep and goats, this may be the regulator of the length of diestrus when CL fails to secrete progesterone, a burst of FSH follows causing development of the new follicle and pro-estrus. Progesterone also acts on the mammary glandular tissue to stimulate milk production (Hafez, 1982). However, the major role of progesterone occurs during pregnancy, as it acts on the endometrium and preparation for indication regardless of whether or not a zygote is present (Hafez, 1982)

The Corpus luteum of pregnancy is known as the corpus luteum Verum and may be larger than the corpus luteum spurium (false yellow body) of the estrus cycle (Hafez, 1982), and in cattle, it increases in size for two to three months of gestation, then regresses for four to six months and thereafter remains relatively constant until calving, when it degenerates within one week. Physiological half-life of the progesterone is only 22 – 36 minutes, this mean that a constant secretion is essential to maintain the circulating level (MacDonald, 1980). He further stated that in a functional ovary, progesterone rises to a peak at days 90 to 100 and then decline until days 180 to 200 of pregnancy, but a second rise of progestin occurs and lasts until parturition. The sources of the first progesterone rise are the primary and accessory corpra lutea, and the source of the second rise of progestin is the

placenta (Hafez, 1982).

Influence of breed on ovulation, ovary activity and kidding rates

Dauda (1986) reported that there was a marked breed effect on the ovulation, ovarian activity and kidding in Borno White than in the Red Sokoto breeds of goats. Within the period of cyclical ovarian activity, the most consistent time changes were observed in Red Sokoto goats, when the duration of the oestrus cycle increased progressively and the ovulation rate gradually declined as dry season advances (Hambolu and Ojo, 1985).

Occurrence of infantile ovary among native goats

Hafez (1980) stated that agenesis of one or both ovaries is seldom observed in ruminant animals, but in bilateral agenesis, the tubular genitalia may be absent as part of the defect or, if present, are infantile (under developed). A supernumerary and accessory ovary occurs very rarely in domestic animals (Jubb and Kennedy, 1970). Same authors further stated that, an accessory ovary is located close to a normally placed gonad which is usually connected to it, and appears to develop as a result of embryonic gonad.

Infantile ovaries (hypoplasia) occur more often in cattle, but may probably occur in other species (Jubb and Kennedy, 1970). They further explained that in association with ovarian hypoplasia, there is relative hypoplasia or infantilism of the remainder of the genital tract. Nevertheless, genital infantilism also occurs in young female goats in association with non – functional ovaries of debility or malnutrition (Jubb and Kennedy, 1970). These workers finally concluded that the occurrence of ovarian hypoplasia or infantile ovaries in native goats is as a result of genetic defect conditioned by autosomal recessive gene with incomplete penetrance.

Hypoplasia occurred in Swedish mountain cattle, where affected animals have infantile reproductive tracts and never exhibit estrus. Ovarian hypoplasia tends to be associated with white coat colour, being inherited as an autosomal recessive gene. An infantile ovary in goats appears due to a recessive gene linked to the dominant autosomal twin gene for polledness and found to be more frequent in some breeds than others (Jubb and Kennedy, 1970).

Cause and occurrence of infantile ovaries and frequency among local breeds

Several reasons could be responsible for the occurrence of infantile ovaries among farm animals. It could be due to, infection, genetics, nutritional, and hormonal imbalance and or environmental factors in association with the effect of season (Hafez, 1982). The occurrence of infantile ovary through non – infectious means could be by coitus, where a buck with an autosomal recessive gene with incomplete penetrance mate a female, it could also occur due to gene linkage e.g. autosomal gene for polledness, but this varies with breed (Hafez, 1982).

In female carrying twin pregnancy, when there is hormonal imbalance or disturbance from the male twin that passed through placental infusion to the female co-twin, the female is bound to have an infantile ovary (Hafez, 1982). This problem is not common in sheep and goats, but if it occurs, causes masculitrization of female (Jubb and Kennedy, 1970). Likewise, when excess androgen secretion occurs in female fetuses at an early stage of gestation, retardation of female genitalia development occurs, but on the contrary external genitalia development is pronounced, resulting in Pseudo-hermophroditism (Hafez, 1982). Malnutrition during or before gestation period or Vitamin deficiency from feeds offered as well as minerals are other reasons advanced for occurrence of infantile ovaries vitamin E and Selenium being good examples. He further explained that the percentage of infantile ovary among breeds vary incidence is very low in ruminants like sheep and goats.

CONCLUSION AND RECOMMENDATIONS

It is concluded that, genetic and environmental factors also create considerable variations in the reproduction performance of goats. Seasonal variation coupled with genetic and environmental factors are some of the major hindrance that influences the production performance of different breeds of goats in the tropics. Furthermore, reproductive efficiency in any given species of animal depends on several other factors such as, age, oestrus cycle, litter size, gestation length, and length of breeding season, suckling period and

duration of reproduction period. Also the pattern of testicular development, endocrine function and semen trait in the male are influenced by genetic and environmental factors such as disease, nutrition, location and season. It is worth noting also that information on the reproductive efficiency of indigenous goats is rare. It was recommended that farmers' better understanding of productivity potentials of indigenous breeds of goats can be accessed through their sperm production capacity which is a function of hormonal influence in males, as well as Oogenesis and ovarian development in the female. Also body condition score which is a function of nutritional status of an animal and the absence of diseases and the overall performance of any class of animal is directly linked to body condition score at mating.

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